

[54] **MOLDING PLASTIC COATED
NITROCELLULOSE**

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[58] Field of Search149/8, 12, 92, 100; 264/3 E, 264/3 R

[56] **References Cited**
UNITED STATES PATENTS

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[57] **ABSTRACT**

A hot-molded solid-propellant or priming charge and the method of making the charge. Nitrocellulose grains are coated with plasticized polyvinyl acetate and then heated and compression molded whereupon the hot molded components retain their geometry and dimensional recovery is negligible. High explosive can be added to the charge prior to molding in order to improve quickness and burning rate of the charge.

5 Claims, No Drawings

MOLDING PLASTIC COATED NITROCELLULOSE

This invention relates in general to solid propellant charges and an improved method of molding such charges. More specifically, the invention relates to a hot molding method of compression molding a solid propellant charge.

The recent interest in caseless ammunition has resulted in increased efforts to provide molded propellant charges which are easy and economical to manufacture, safe to store and handle, and ballistically suitable for the purposes intended. The advantages and objectives of caseless ammunition are well documented in the prior art and need not be repeated here. Among the more pertinent recent patents in this field are U.S. Pat. No. 3,212,440 issued to J. B. Quinlan et al. on Oct. 19, 1965, and U.S. Pat. No. 3,282,751, issued to J. B. Quinlan et al. on Nov. 1, 1966.

A second, somewhat similar field of interest in which molded propellant charges are very important is the expendable cartridge case concept as disclosed in such U.S. patent applications as Ser. No. 686,508, filed by J. J. Scanlon on Nov. 29, 1967, now U.S. Pat. No. 3,485,170, and Ser. No. 755,649, filed by M. W. Kordas et al., on Aug. 27, 1968. The present invention was developed for this type of expendable cartridge.

One of the deficiencies of the type of wet molding process disclosed in the Quinlan et al. U.S. Pat. No. 3,282,751 cited above is that it is very difficult to reproduce dimensions of the molded article. Because of this, the molded article must be machined or otherwise brought to the desired dimensions. Obviously, such a method leaves much to be desired in a mass production operation. With the present invention, it is possible to stamp propellant charges quickly and efficiently like bullets. The hot molded components retain their geometry and recovery is negligible. A further advantage of the hot molding process of the present invention is that it does not require collodion (nitrocellulose dissolved in ether-alcohol) so that the hot molding process is considerably less hazardous than the cold molding process disclosed in the Quinlan U.S. Pat. No. 3,282,751. The present invention permits the addition of other ingredients, e.g., high explosives such as PETN, RDX, HMX, and tetrazene to the charge by coating the ingredients and then compression molding all the ingredients together under suitable heat and pressure into the desired configuration and dimensions.

In addition to solid propellant charges being molded according to the present invention, primer mixes have been molded in similar fashion.

It is an object of this invention to provide an improved molded propellant charge of higher loading density.

Another object of the invention is to provide a method of hot molding propellant charges to consistent and accurate configuration and dimensions.

Another object of the invention is to provide a high strength, molded, unitary propellant charge.

Other objects and advantages will be obvious after reading the specification and the appended claims.

An acceptable process which has been followed to produce molded propellant charges according to this invention is as follows:

1. Using a tumbling barrel, uniformly coat single base, unglazed or uncoated, i.e., with no graphite, nitrocellulose propellant grains with PETN (about 5 minutes) preferably using a quantity of PETN equal to the projected binder content;

2. Spray or drop on the PETN-coated propellant grains while in motion a sufficient quantity of plasticized polyvinyl acetate in alcohol solution to effect the required binder content. Tumble for about 5 minutes. Dry the mixture in any well-known manner;

The polyvinyl acetate polymer solution most frequently used consisted of Borden Company's Lemac 7, 20 percent plasticized by the addition of dibutyl phthalate to the alcoholic solution of the polymer;

3. Heat the PETN and polyvinyl acetate coated propellant mixture to a temperature between from about 180° F. to about 230° F.; and

4. Compression-mold the heated propellant charge under pressure of about 6,000 p.s.i. to about 10,000 p.s.i. to its final configuration and dimensions.

Other binders, such as acrylic plastic and cellulose acetate, which are compatible with nitrocellulose can be used in place of polyvinyl acetate. In general, the plastic should preferably not have any fluorine or chlorine, which upon ignition would form an acid that would be corrosive to the gun barrel. A binder content of about 1.2 percent polyvinyl acetate (by weight) has been found practical for most nitrocellulose propellants. Binder is applied from a suitable solvent solution, methyl or ethyl alcohol or other suitable solvent which has little or no solvent effect on nitrocellulose. A solvent solution of 10–20 percent concentration is preferred.

To offset the deterrent effect of the binder, a quantity of high explosive, preferably PETN, preferably equal to the binder content is used. As mentioned above, other explosives such as RDX, HMX, or tetrazene may be used. Obviously, if the molded propellant charge does not require the same quickness and/or burning rate as the original unmolded propellant grains, the quantity of PETN can be decreased—or even eliminated altogether. However, in this case, i.e., with no PETN or other suitable high explosive added, the molded propellant charge will have a lower quickness and burning rate since the binder does act as a deterrent to ignition and burning.

It should be appreciated that the temperature at which the propellant-binder mix is molded and the pressure used are related since a low temperature can be used with a high pressure and visa versa.

As mentioned above, primer mix has also been hot molded into discs in accordance with the technique of the present invention. A mix of 80 percent tetrazene and 20 percent mannitol hexanitrate has been successfully hot molded. Although the tetrazene-mannitol hexanitrate mix was heated to the temperature range used with nitrocellulose, the percentage of polyvinyl acetate was increased to 2 percent, and the pressure used was 10,000 p.s.i. Tetrazene pellets were also formed by the same technique.

The process outlined above is suitable for laboratory purposes. However, for large scale production, water dispersions would be preferred and the binder solids content held to that concentration which can be effectively sprayed.

For example, commercial dispersions such as DuPont Elvacet or Borden Company's 804 PL plasticizer with dibutyl phthalate (15–25 percent) or other compatible plasticizer can be effectively sprayed in concentrations of 30–35 percent plasticized solids by weight, plasticization being accomplished by stirring 20–30 minutes after the addition of the required water and plasticizer to the commercial dispersion (55 percent polyvinyl solids by weight) to bring the plasticized solids content to the desired concentration (30–35 percent). Higher concentrations can be used if the dispersion is sprayed hot (160° F.) An ideal process would consist of hot spraying into heated tumbling barrel or other suitable mixes. This would permit rapid drying of the ovated propellant.

Although the laboratory work in hot molding propellant charges was done by heating the binder-coated propellant grains in an oven, it should be understood that the present hot molding process is not intended to be so limited. Thus, other methods of heating the propellant grains such as dielectric or ultrasonic heating can be used within the scope of this application.

What is claimed is:

1. A method of molding a solid propellant charge comprising the steps of:

1. coating individual unglazed powder grains of a single base nitrocellulose propellant with a plasticized thermoplastic binder, said binder constituting about 1.2 percent by weight of the final propellant charge and being compatible, non-acid forming plastic material selected from the group consisting of acrylic plastic, polyvinyl acetate, and cellulose acetate;

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- 2. heating the binder-coated nitrocellulose propellant grains to a temperature of between about 180° F. to about 230° F;
- 3. compression molding the heated and plastic binder-coated propellant grains under pressure of between about 6,000 psi to about 10,000 psi into the desired configuration and dimensions.
- 2. A method of molding a solid propellant charge as recited in Claim 1 wherein said nitrocellulose propellant grains are uniformly coated with a high explosive prior to being coated with said plastic binder so as to increase the quickness of the solid propellant charge.
- 3. A method of molding a solid propellant charge as recited in Claim 2 wherein said high explosive is PETN.
- 4. A method of molding a solid primer charge comprising the steps of:

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- 1. coating grains of a primer mix comprising about 80 percent tetrazene and about 20 percent mannitol hexanitrate with about 2 percent plasticized polyvinyl acetate binder by weight;
- 2. heating the coated explosive grains to a temperature of between about 180° to about 230° F., and
- 3. compression molding the heated explosive grains under about 10,000 p.s.i. pressure into the desired configuration.
- 5. A method of molding a solid propellant charge as recited in claim 1 in which the coating step comprises the distributing of the desired quantity of plasticized thermoplastic binder on to the nitrocellulose grains followed by tumbling of the coated propellant grains and finally drying of the mixture.

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